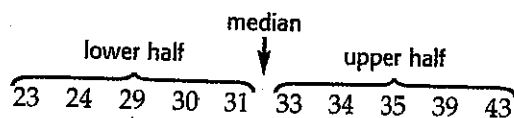


8 Box-and-Whisker Plots

Name _____

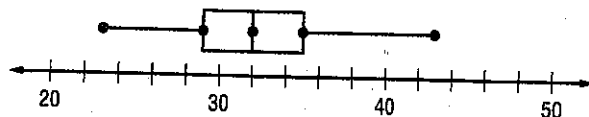
In a set of data, **quartiles** are values that divide the data into four equal parts.



The median of the lower half of a set of data is the **lower quartile**, or LQ.

The median of the upper half of a set of data is the **upper quartile**, or UQ.

- To make a **box-and-whisker plot**, draw a box around the quartile values, and lines or *whiskers* to represent the values in the lower fourth of the data and the upper fourth of the data.

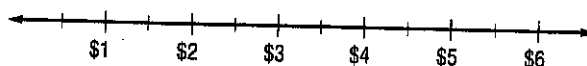


Example 1

MONEY The amount spent in the cafeteria by 20 students is shown. Display the data in a box-and-whisker plot.

- Step 1** Find the least and greatest number. Then draw a number line that covers the range of the data. In this case, the least value is 1 and the greatest value is 5.5.

Amount Spent			
\$2.00	\$2.00	\$1.00	\$4.00
\$1.00	\$2.50	\$2.50	\$2.00
\$2.50	\$1.00	\$4.00	\$2.50
\$3.50	\$2.00	\$3.00	\$2.50
\$4.00	\$4.00	\$5.50	\$1.50



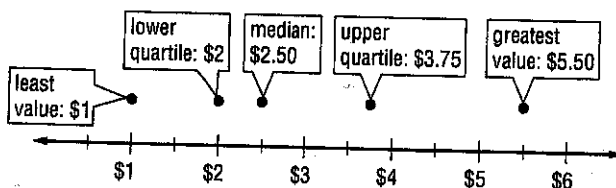
- Step 2** Find the median, the extreme values, and the upper and lower quartiles. Mark these points above the number line.

1, 1, 1, 1.5, 2, 2, 2, 2, 2.5, 2.5, 2.5, 2.5, 2.5, 3, 3.5, 4, 4, 4, 4, 5.5

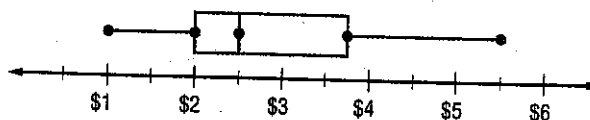
$$\text{LQ} = \frac{2 + 2}{2} \text{ or } 2$$

$$\text{M} = \frac{2.5 + 2.5}{2} \text{ or } 2.5$$

$$\text{UQ} = \frac{3.5 + 4}{2} \text{ or } 3.75$$



- Step 3** Draw a box and the whiskers.



- The **interquartile range (IQR)** is the range of the middle half of the data and contains 50% of the data in the set.

$$\text{Interquartile range} = \text{UQ} - \text{LQ}$$

The interquartile range of the data in Example 1 is $3.75 - 2$ or 1.75.

- An **outlier** is any element of a set that is at least 1.5 interquartile ranges less than the lower quartile or greater than the upper quartile. The whisker representing the data is drawn from the box to the least or greatest value that is not an outlier.

Example 2

SCHOOL The number of hours José studied each day for the last month is shown in the box-and-whiskers plot below.

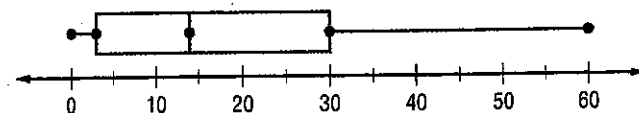


- What percent of the data lies between 1.5 and 3.25?
The value 1.5 is the lower quartile and 3.25 is the upper quartile. The values between the lower and upper quartiles represent 50% of the data.
- What was the greatest amount of time José studied in a day?
The greatest value in the plot is 6, so the greatest amount of time José studied in a day was 6 hours.
- What is the interquartile range of this box-and-whisker plot?
The interquartile range is $UQ - LQ$. For this plot, the interquartile range is $3.25 - 1.5$ or 1.75 hours.
- Identify any outliers in the data.
An outlier is at least $1.5(1.75)$ less than the lower quartile or more than the upper quartile. Since $3.25 + (1.5)(1.75) = 5.875$, and $6 > 5.875$, the value 6 is an outlier, and was not included in the whisker.

Exercises

DRIVING For Exercises 1–3, use the following information.

Tyler surveyed 20 randomly chosen students at his school about how many miles they drive in an average day. The results are shown in the box-and-whisker plot.



- What percent of the students drive more than 30 miles in a day?
- What is the interquartile range of the box-and-whisker plot?
- Does a student at Tyler's school have a better chance to meet someone who drives the same mileage they do if they drive 50 miles in a day or 15 miles in a day? Why?
- SOFT DRINKS** Carlos surveyed his friends to find the number of cans of soft drink they drink in an average week. Make a box-and-whisker plot of the data.
{0, 0, 0, 1, 1, 1, 2, 2, 3, 4, 4, 5, 5, 7, 10, 10, 10, 11, 11}
- ANIMALS** The average life span of some animals commonly found in a zoo are given below. Make a box-and-whisker plot of the data.
{1, 7, 7, 10, 12, 12, 15, 15, 18, 20, 20, 20, 25, 40, 100}
- BASEBALL** The table shows the number of sacrifice hits made by teams in the National Baseball League in the 2001 season. Make a box-and-whisker plot of the data.

Team	Home Runs	Team	Home Runs
Arizona	71	Milwaukee	65
Atlanta	64	Montreal	64
Chicago	117	New York	52
Cincinnati	66	Philadelphia	67
Colorado	81	Pittsburgh	60
Florida	60	San Diego	29
Houston	71	San Francisco	67
Los Angeles	57	St. Louis	83

Source: ESPN

WLP

with Homework

Example Exercises

- 1 7-10, 14, 17
- 2 11-12
- 3 13, 18



Online Resources

CLASSZONE.COM

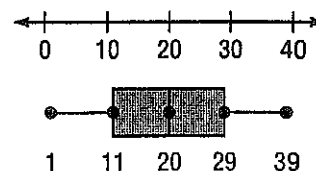
More Examples

eTutorial Plus

Practice and Problem Solving

7. Choose the set of data that is displayed in the box-and-whisker plot.

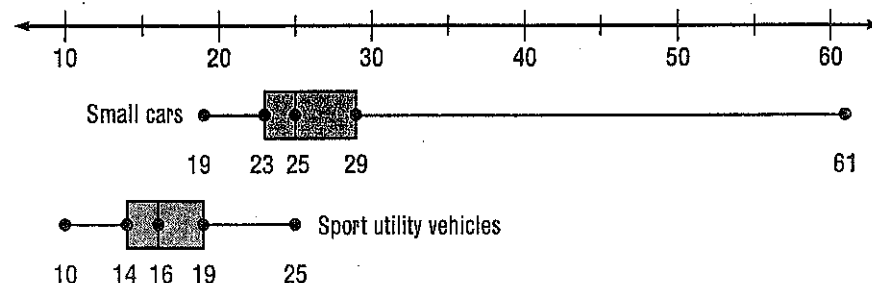
- A. 1, 30, 39, 12, 13, 20, 11, 22, 29
 B. 12, 28, 13, 10, 1, 39, 30, 20, 22



Make a box-and-whisker plot of the data.

- ~~X~~ Hourly rates of pay: 8.75, 7.50, 9, 8, 6.50, 8, 6.50, 7, 6, 7, 6.25
~~X~~ Pages per chapter in a book: 21, 25, 20, 14, 15, 19, 14, 14, 10, 25
~~X~~ Ages of roller rink employees: 24, 22, 30, 18, 29, 38, 33, 17, 22, 25, 16, 41

Fuel Economy The box-and-whisker plots show the average miles per gallon of gasoline used in city driving for 2002 models of small cars and sport utility vehicles.



11. Compare the number of small cars that get less than 25 miles per gallon with those that get more than 25 miles per gallon.
12. About what fraction of the sport utility vehicles get less than 14 miles per gallon?
13. **Writing** Make a conclusion comparing the two groups of vehicles.

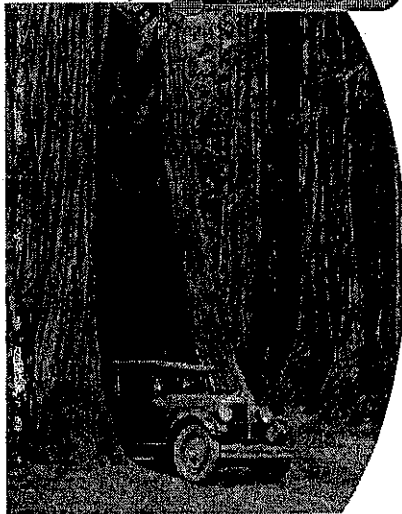
Trees In Exercises 14 and 15, use the heights, to the nearest foot, of coastal redwood trees known to be over 340 feet tall listed below.

359, 361, 363, 358, 368, 361, 366, 360, 358, 359, 358, 366, 363, 364, 358, 363

14. Make a box-and-whisker plot of the data.
15. Suppose the tallest tree is struck by lightning and its height is reduced to 352 feet. Make a box-and-whisker plot for the new data. How does this plot differ from the one that you made in Exercise 14?
16. **Critical Thinking** Suppose you have to make a box-and-whisker plot for an unordered data set with 50 values. Explain how a stem-and-leaf plot of the data can help you make the box-and-whisker plot.

What do you think?

Science



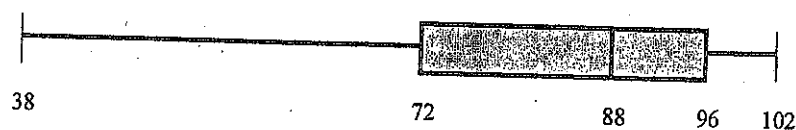
Redwood Trees

Suppose the arch in a redwood tree is 2.1 meters high. Can a truck that is 260 centimeters tall pass through the arch?

____ Period ____
Box & Whisker Worksheet

For questions 1 – 6, refer to the box & whisker graph below which shows the test results of a math class.

Test Scores (as %) for 6th Period



- _____ 1. What was the high score on the test?
- _____ 2. What percent of the class scored above a 72?
- _____ 3. What was the median score on the test?
- _____ 4. What percent of the class scored between 88 & 96?
5. Do you think that this test was too hard for the students? Explain.
- _____
- _____
6. Would you expect the mean to be above or below the median? Explain.
- _____
- _____

For questions 7 – 11 refer to the box & whisker graph below that shows how much time was spent per night on homework for sophomore class at a certain high school during September.

Average Minutes Per Night Spent On Homework

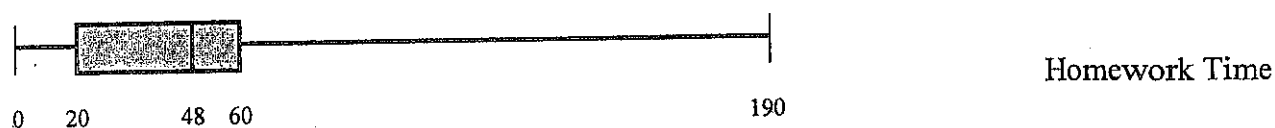


- _____ 7. What percent of the sophomores spend more than 60 minutes on homework per night?
- _____ 8. What is the range of times that the middle 50% of the sophomores spend on homework per night?

- _____ 9. How many sophomores do not do homework?
- _____ 10. What percent of the sophomores spend less than 20 minutes per night on homework?
11. Would you expect the mean number of minutes per night to be higher or lower than the median? Explain.
- _____
- _____

For questions 12 – 23, refer to the box & whisker graphs below that compare homework time per night with TV time per night for the same group of sophomores.

TV & Homework Minutes per Night



- _____ 12. What percent of the sophomores watch TV for at least 15 minutes per night?
- _____ 13. What is the 3rd quartile for the TV time data?
14. Is it more common for a sophomore at this high school to spend more than 1 hour on homework or more than 1 hour watching TV? Explain.
- _____
- _____
- _____

For questions 15 – 23, identify if each statement is true, false, or cannot be determined.

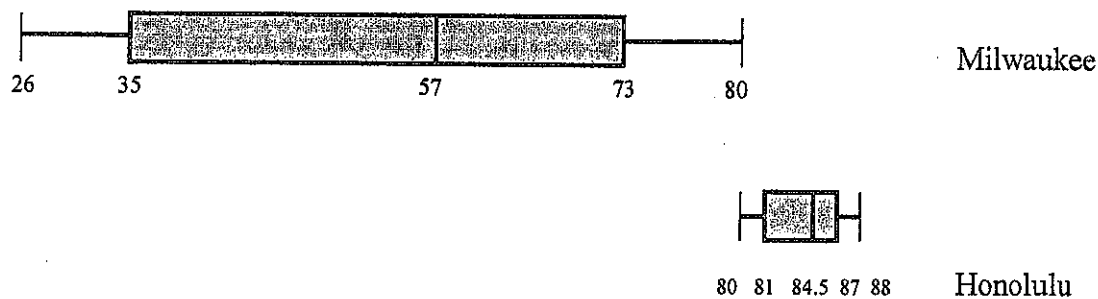
- _____ 15. Some sophomores didn't watch TV that month.
- _____ 16. The TV box & whisker graph contains more data than the homework graph.
- _____ 17. 25% of the sophomores spend between 48 & 60 minutes per night on homework.

- _____ 18. 15% of the sophomores didn't watch TV that month.
- _____ 19. In general, these sophomores spend more time watching TV than doing homework.
- _____ 20. The TV data is more varied than the homework data.
- _____ 21. The ratio of sophomores who spend more than 110 minutes per night watching TV to those who spend less is about 2:1.
- _____ 22. 225 sophomores watch TV.
- _____ 23. Twice as many sophomores watch TV for more than 1 hour than do homework for more than 1 hour.
24. Suppose that one family kept track of how many DVDs they rented each month for a two year period. The numbers for each month are shown in the table below. Make a box & whisker graph from this data.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
3	5	2	8	1	5	0	3	6	4	9	15	3	6	4	1	10	3	8	7	2	9	0	11

For question 25, refer to the box & whisker graphs below that show the average monthly high temperatures for Milwaukee, Wisconsin & Honolulu, Hawaii.

Average Monthly High Temperatures



25. Write a short paragraph comparing the temperatures in both cities.
